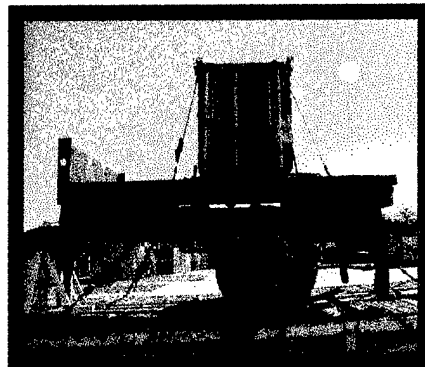
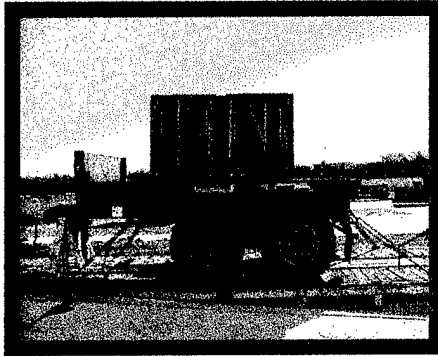


FINAL REPORT
MAY 2000

REPORT NO. 99-12



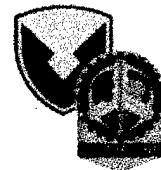
DTIC QUALITY INSPECTED 4

TRAILER CARGO, 2.5-TON MTV M1082, AND TRAILER CARGO, 5-TON MTV, M1095, TP-94-01, TRANSPORTABILITY TESTING PROCEDURES

Prepared for:

U.S. Army Tank-automotive
and Armaments Command
ATTN: SFAE-GCSS-W-MTV
Warren, MI 48397-5000

Distribution Unlimited



**VALIDATION ENGINEERING DIVISION
MCALESTER, OKLAHOMA 74501-9053**

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**REPORT NO. 99-12
TRAILER CARGO, 2.5-TON MTV M1082,
AND TRAILER CARGO, 5-TON MTV, M1095,
TP-94-01, TRANSPORTABILITY TESTING PROCEDURES**

MAY 2000

ABSTRACT

The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SMAAC-DEV), was tasked by the U.S. Army Tank-automotive and Armaments Command (TACOM) to conduct TP-94-01, "Transportability Testing Procedures," on the Trailer Cargo, 2.5 Ton MTV M1082, and Trailer Cargo, 5-Ton MTV, M1095, hereinafter referred to in this report as 2.5-ton and 5-ton tactical trailers, manufactured by Stewart and Stevenson Services, Inc., Tactical Vehicle Systems Division, Sealy, Texas.

The trailers were loaded with 155MM Separate Loading Projectiles (SLPs) and 120MM Tank Ammunition on metal pallets simulating the maximum trailer payload. The trailers were tested and evaluated in accordance with the testing procedures of TP-94-01, "Transportability Testing Procedures." Testing included rail impact tests at 4, 6, and 8.1 mph forward, and 8.1 mph in the reverse direction, hazard course, and road course. The satisfactory performance of the 2.5-ton and 5-ton tactical trailers during testing has demonstrated that they are adequate to transport ammunition.

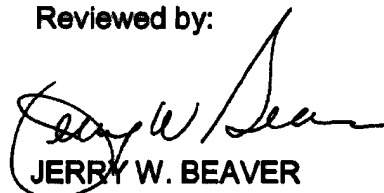
Prepared by:



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VALIDATION ENGINEERING DIVISION
MCALESTER, OK 74501-9053

REPORT NO. 99-12

**TRAILER CARGO, 2.5-TON MTV M1082,
AND TRAILER CARGO, 5-TON MTV, M1095,
TP-94-01, TRANSPORTABILITY TESTING PROCEDURES**

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PART 1 – INTRODUCTION

A. **BACKGROUND.** The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SMAAC-DEV), was tasked by the U.S. Army Tank-automotive and Armaments Command (TACOM) to conduct transportability testing procedures on the Trailer Cargo, 2.5-Ton MTV, M1082 and Trailer Cargo, 5-Ton MTV, M1095 manufactured by Stewart and Stevenson Services, Inc., Tactical Vehicle Systems Division, Sealy, Texas.

B. **AUTHORITY.** This test was conducted IAW mission responsibilities delegated by the U.S. Army Operations Support Command (PROV), Rock Island, IL. Reference is made to the following:

1. Change 6, AR 740-1, 18 August 1976, Storage and Supply Activity Operation.

2. IOC-R, 10-23, Mission and Major Functions of USADAC, 7 January 1998.

C. **OBJECTIVE.** The objective of the tests was to determine if the 2.5-ton and 5-ton tactical trailers produced by Stewart and Stevenson satisfied the transportability requirements of TP-94-01.

D. **CONCLUSION.** The 2.5- and 5-ton tactical trailers were tested in accordance with the Transportability Testing Procedures TP-94-01. Minor deficiencies were found during testing, but they had no impact on the ability of the trailers to safely transport ammunition. The satisfactory performance of the 2.5-ton and 5-ton tactical trailers during testing has demonstrated that they are adequate to transport ammunition.

PART 2 - ATTENDEES

DATES PERFORMED: MARCH 29-31, 2000

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McAlester, OK 74501-9053

PART 3 – TEST EQUIPMENT

1. Trailer Cargo, 2.5-Ton MTV, M1082

NSN: 2320-Z3-606-8001

Contract #: DAAE07-98-C-M1018

Stewart and Stevenson Services, Inc.

Tactical Vehicle Systems

Sealy, TX 77474

VSN/USA PB029X

MFG Serial # TL-011120BEKG

MFG Date: 11-98

Del Date: 12-98

WEIGHTS	TONGUE	WHEEL	TOTAL
Curb	750	2,880	6,510
Gross	1,400	5,055	11,510

2. Trailer Cargo, 5-Ton MTV, M1095

NSN: 2320-Z9-017-2001

Contract #: DAAE07-98-C-M1018

Stewart and Stevenson Services, Inc.

Tactical Vehicle Systems

Sealy, TX 77474

VSN/USA PB029X

MFG Serial # TL-011295BEKG

MFG Date: 11-98

Del Date: 12-98

WEIGHTS	TONGUE	WHEEL	TOTAL
Curb	800	4,200	9,200
Gross	1,924	8,638	19,200

PART 4 - TEST PROCEDURES

The test procedures outlined in this section were extracted from TP-94-01, "Transportability Testing Procedures," dated July 1994. This document identifies the testing requirements for validating tactical vehicles and outloading procedures used for shipping munitions by intermodal freight containers, commercial or tactical truck, or trailer or railcar. The transportability tests that were conducted on the 2.5-ton and 5-ton tactical trailers are summarized below.

A. **TEST PREPARATION.** The test load was prepared using the blocking and bracing procedures proposed for use with munitions (see part 6 for procedures). The first rail impact test was conducted with the loaded 2.5-ton and 5-ton tactical trailers loaded to capacity and secured to the railcar. Inert (non-explosive) items were used to build the load. The weight and physical characteristics (weights, physical dimensions, center of gravity, etc.) of the test loads were identical to live (explosive) ammunition.

B. **RAIL IMPACT TEST METHOD.** The trailers were loaded and secured to a conventional friction draft gear flatcar. MTMC-TEA Pamphlet 55-19, "Tiedown Handbook for Rail Movements" procedures were used to secure the trailers to the flatcar. Equipment needed to perform the test included the specimen (hammer) car, four (4) empty railroad cars connected together to serve as the anvil, and a railroad locomotive. The anvil cars were positioned on a level section of track with air and hand brakes set and with draft gears compressed. The locomotive unit pushed the specimen car toward the anvil at a predetermined speed, then disconnected from the specimen car approximately fifty (50) yards away from the anvil cars allowing the specimen car to roll freely along the track until it struck the anvil. This constituted an impact. Impacting was accomplished at speeds of 4, 6, and 8.1 mph in one direction and at a speed of 8.1 mph in the reverse direction. The 4 and 6 mph impact speeds were

approximate; the 8.1 mph is a minimum. Impact speeds were determined by using an electronic counter to measure the time for the specimen car to traverse an eleven-foot distance immediately prior to contact with the anvil cars (see Figure 1).

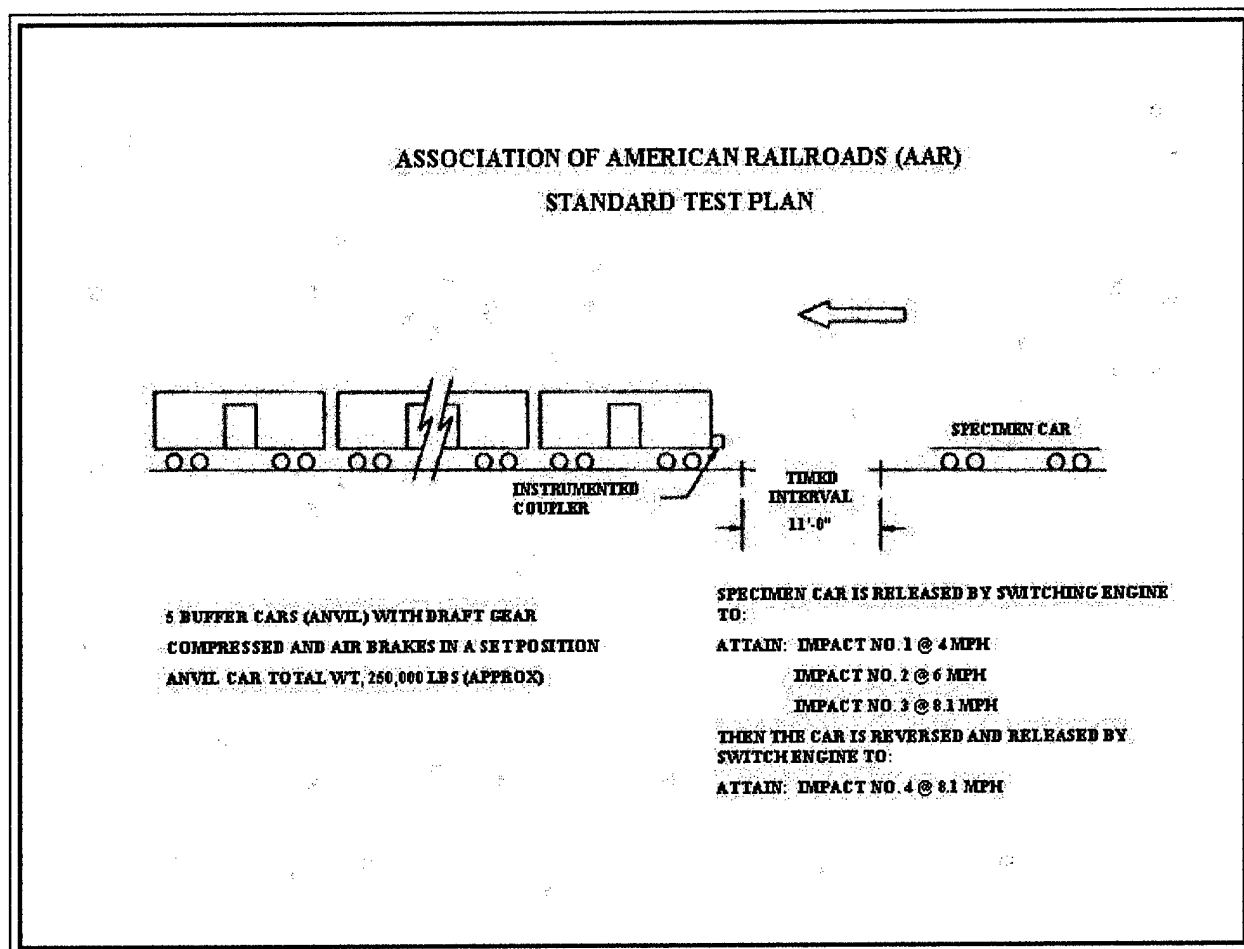


Figure 1

C. **HAZARD COURSE.** The loaded 2.5-ton and 5-ton tactical trailers were transported over the 200-foot-long segment of concrete-paved road that consists of two series of railroad ties projecting 6 inches above the level of the road surface. The hazard course was traversed two times (see figure 2).

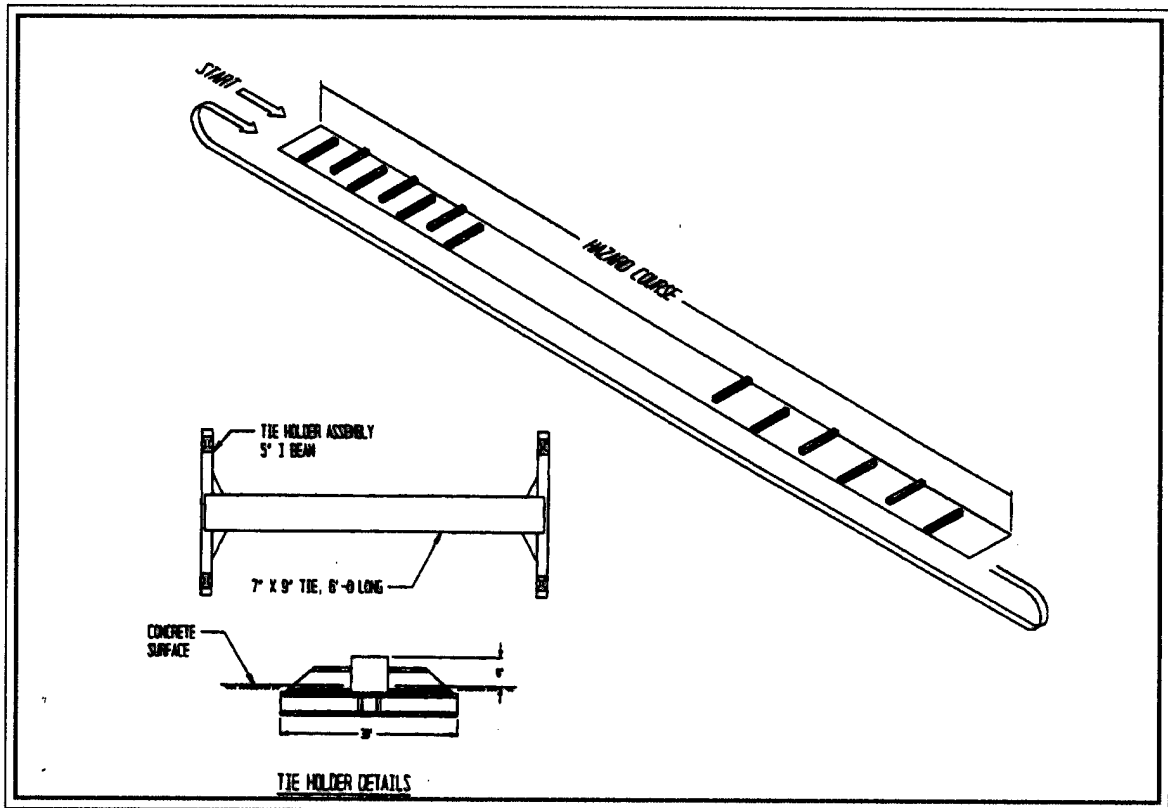


Figure 2.

1. The first series of ties are spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.
2. Following the first series of ties, a paved roadway of 75 feet separates the first and second series of railroad ties.
3. The second series of ties are spaced on 10-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.

4. The test load is driven across the hazard course at speeds that would produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 mph).

D. **ROAD TRIP.** The loaded 2.5-ton and 5-ton tactical trailers were transported for a distance of 30 miles over a combination of roads surfaced with gravel, concrete, and asphalt. The test route included curves, corners, railroad crossings, and stops and starts. The trailers traveled at the maximum speed for the particular road being traversed, except as limited by legal restrictions.

E. **PANIC STOPS.** Upon completion of the road trip, the loaded trailers were subjected to three full airbrake stops while traveling in the forward direction and one in the reverse direction. The first three stops were at 5, 10, and 15 mph, while the stop in the reverse direction was at approximately 5 mph.

F. **WASHBOARD COURSE.** The loaded 2.5-ton and 5-ton tactical trailers were driven over the washboard course at a speed that produced the most violent response in the trailers.

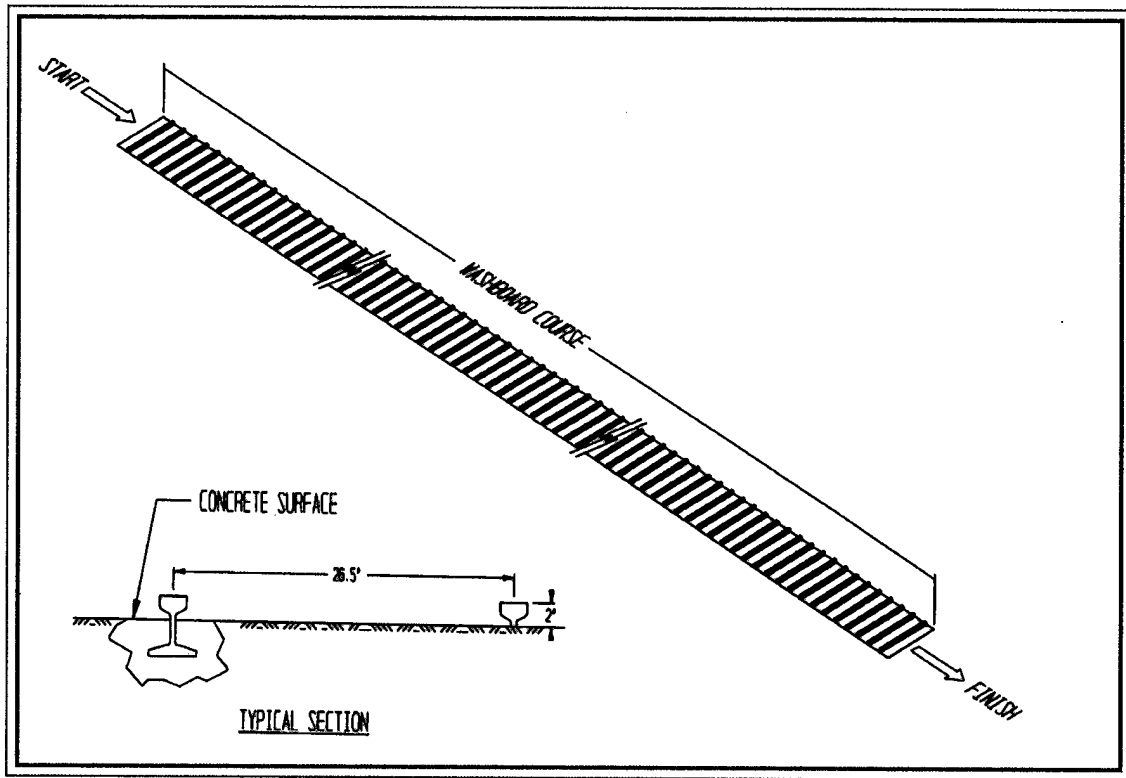
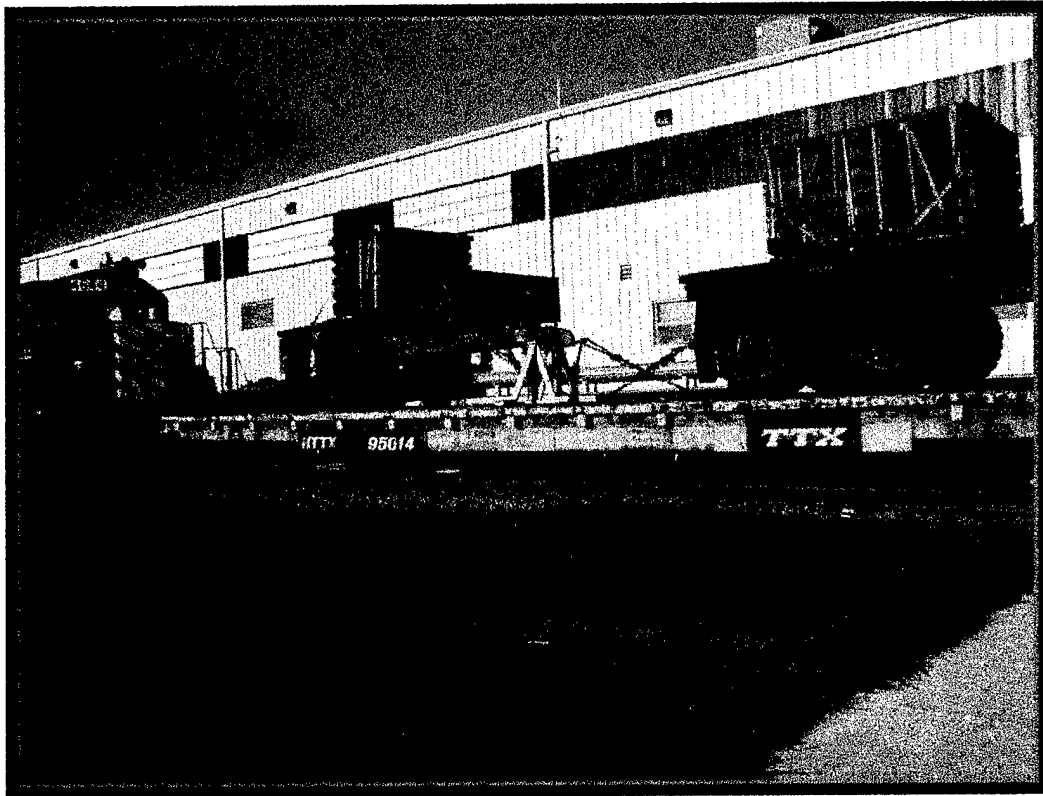


Figure 3.

PART 5 - TEST RESULTS

TEST SEQUENCE 1

The 2.5-ton and 5-ton tactical trailers were each loaded with inert 120MM tank ammunition to the specified trailer design payload. The 120MM test load was prepared using the blocking and bracing procedures proposed for use with munitions (see Part 6-Drawings, pages 2 and 4). Tie down of the trailers to the flat car was conducted in accordance with MTMC-TEA Pamphlet 55-19, "Tiedown Handbook for Rail Movements."



Rail Impact Testing of 2.5-Ton and 5-Ton Trailers

A. **Rail Impact Data**

Test Date: 13 January 2000

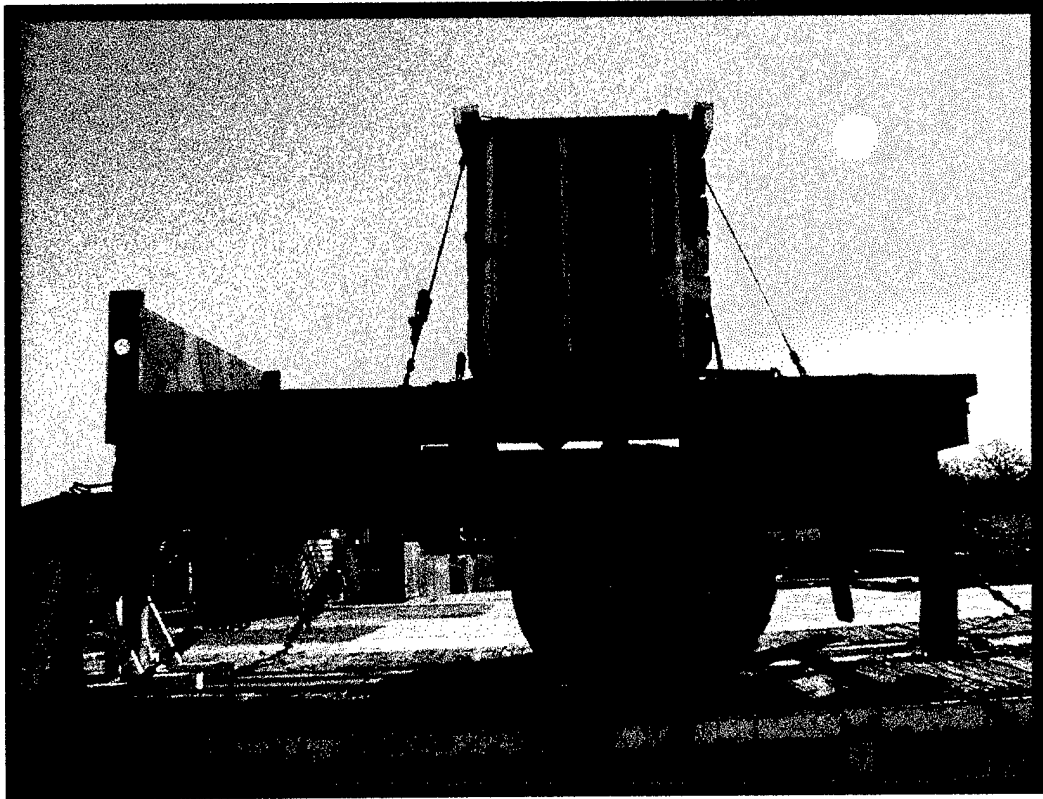
Specimen Load: 2.5-Ton Tactical Trailer loaded with 120MM tank ammunition

5-Ton Tactical Trailer loaded with 120MM tank ammunition

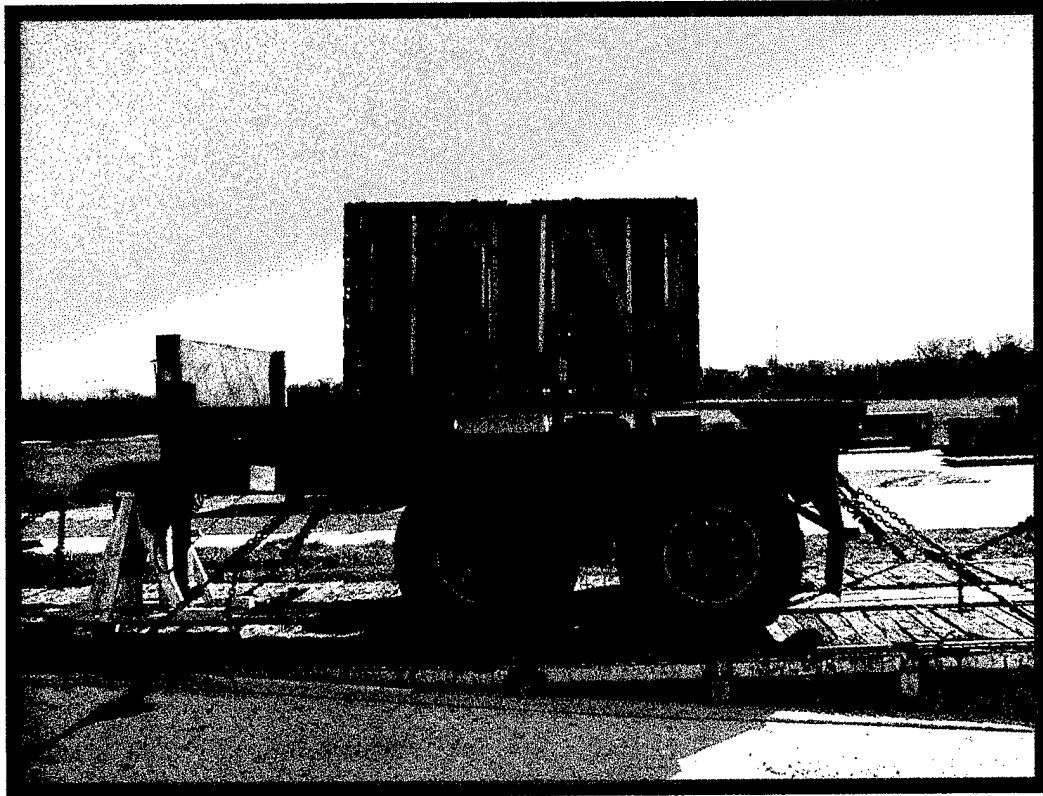
DESCRIPTION	WEIGHT
Flat Car Number: HTTX 95014	67,800 pounds
2.5-Ton Tactical Trailer	6,510 pounds
5-Ton Tactical Trailer	9,200 pounds
Load Type: 120MM Tank Ammunition with metal pallets	
- 2.5 - Ton Trailer load	5,150 pounds
- 5 - Ton Trailer load	10,300 pounds
Total Specimen Weight	98,960 pounds
Buffer Car (four cars) Weight:	250,000 pounds

IMPACT NO.	VELOCITY (MPH)
1	4.13
2	6.36
3	8.67
4	8.82

Remarks: No deficiencies were found upon inspection of the trailers and tiedowns following completion of the rail impact testing.



2.5- Ton Tactical Trailer Rail Impact Testing



5-Ton Tactical Trailer Rail Impact Testing

B. Hazard Course

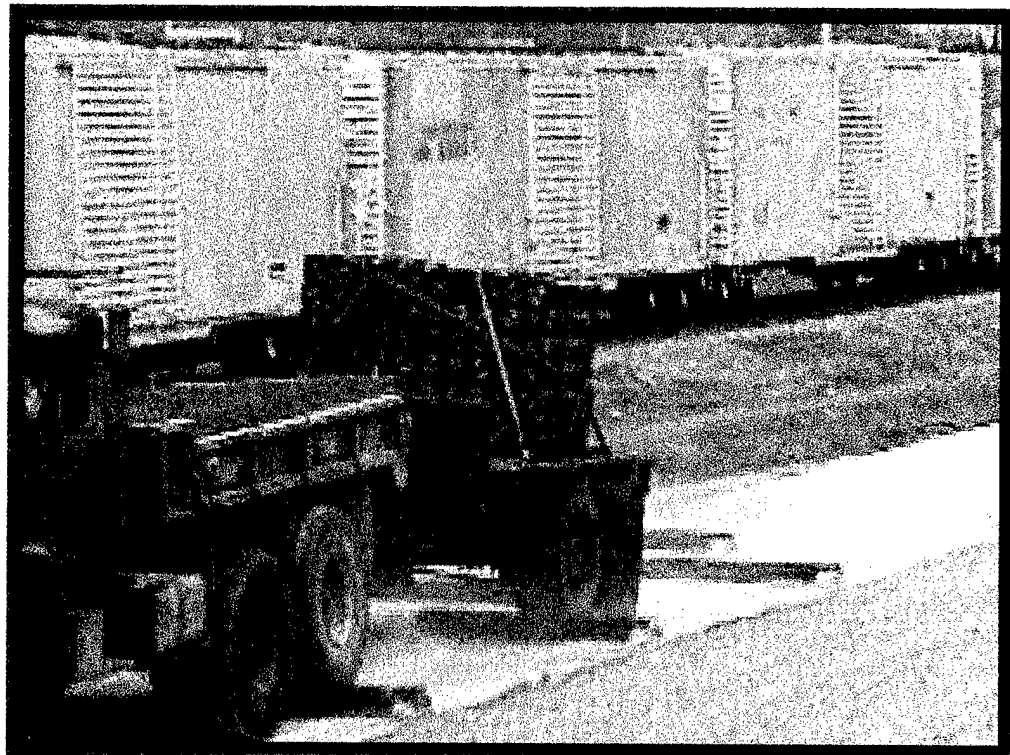
Test Date: 7 January 2000

Specimen Load: 2.5-Ton Tactical Trailer with 120MM Tank Ammunition

PASS NO.	ELAPSED TIME	VELOCITY (MPH)
1	29 Seconds	4.1
2	25 Seconds	4.8
3	22 Seconds	5.4
4	22 Seconds	5.4

Remarks:

1. Lateral movement of load during testing. Three straps were frayed upon completion of testing.
2. No damage or failures occurred with the tie-down rings or trailer.



Hazard Course Testing of 2.5-Ton Tactical Trailer

Test Date: 7 January 2000

Specimen Load: 5-Ton Tactical Trailer with 120MM Tank Ammunition

PASS NO.	ELAPSED TIME	VELOCITY (MPH)
1	18 Seconds	6.6
2	23 Seconds	5.2
3	20 Seconds	6.0
4	20 Seconds	6.0

Remarks:

1. Lateral movement of load during testing. One strap came loose during testing. Strap was relocated and tightened and testing continued.
2. No damage or failures occurred with the tie-down rings or trailer.



Hazard Course Testing of 5-Ton Tactical Trailer

C. **Road Trip**

Test Date: 7 January 2000

Specimen Load: 2.5 -Ton and 5-Ton Tactical Trailers with 120MM Tank
Ammunition

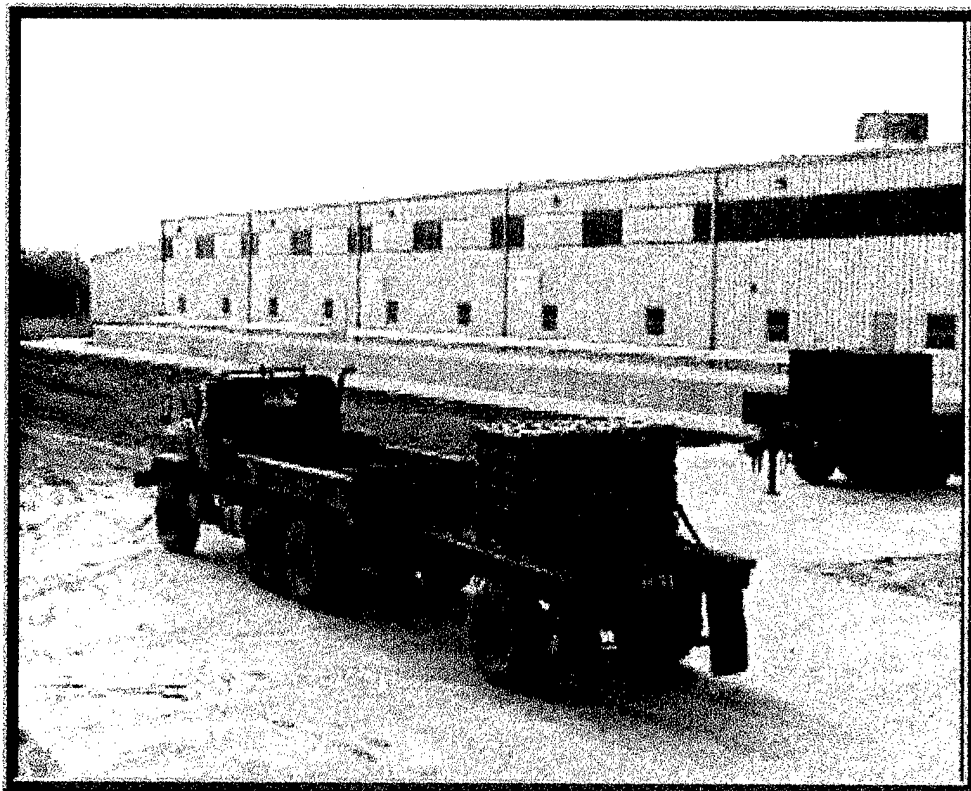
Remarks: No damage or load movement observed after completion of the road
test.

D. **Panic Stop Test**

Test Date: 7 January 2000

Specimen Load: 2.5-Ton and 5-Ton Tactical Trailers with 120MM Tank
Ammunition

Remarks: No damage or load movement observed after completion of test.



Panic Stop Testing of 2.5-Ton Tactical Trailer

E. Washboard Course

Test Date: 7 January 2000

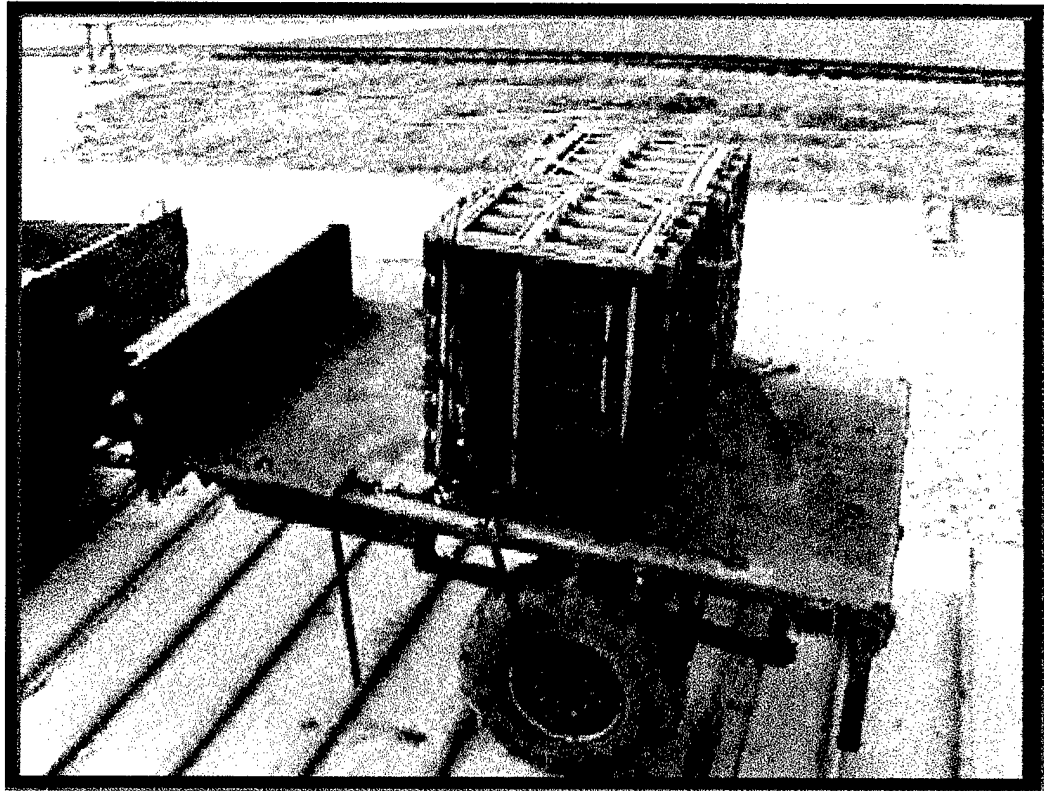
Specimen Load: 2.5-Ton Tactical Trailer with 120MM Tank Ammunition:

Remarks:

1. Three straps broke during testing.
2. Fore and aft movement of the load.
3. No damage or failures occurred with the tie-down rings or trailer.
4. Straps were replaced and strapping board added prior to 13 January 2000 rail impact testing.



2.5-Ton Tactical Trailer Washboard Testing



Broken straps during washboard testing of 2.5-Ton Tactical Trailer

Specimen Load: 5-Ton Tactical Trailer with 120MM Tank Ammunition:

Remarks:

1. No load movement.
2. No damage or failures occurred with the tie-down rings or trailer.

TEST SEQUENCE 2

The 2.5-ton and 5-ton tactical trailers were each loaded with inert 155MM Separate Loading Projectiles (SLPs) to the specified trailer design payload. The 155MM SLP test load was prepared using the blocking and bracing procedures proposed for use with munitions (see Part 6-Drawings, pages 3, 5, and 6). Tie down of the trailers to the flatcar was conducted in accordance with MTMC-TEA Pamphlet 55-19, "Tiedown Handbook for Rail Movements."

A. Rail Impact Data

Test Date: 20 January 2000

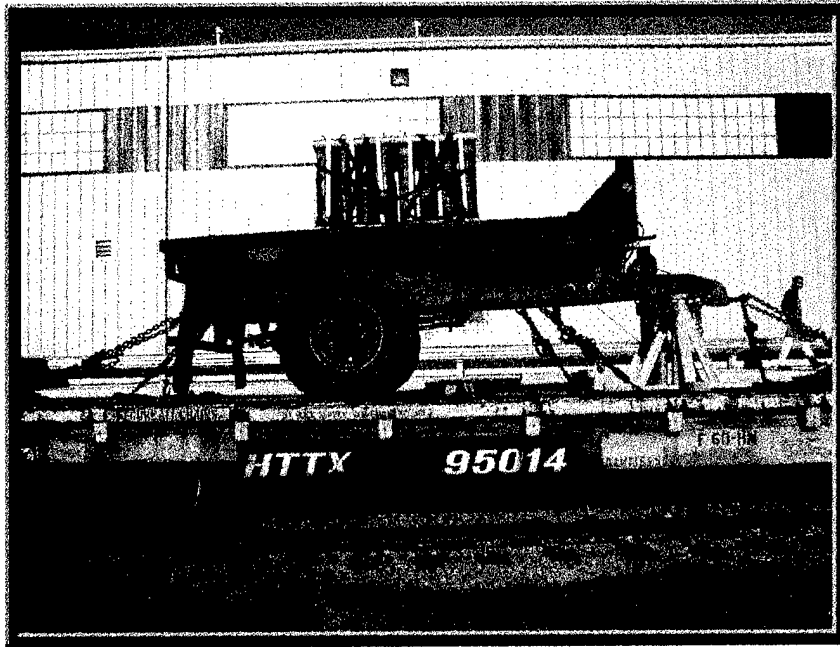
Specimen Load: 2.5-Ton Tactical Trailer loaded with 155MM SLPs

5-Ton Tactical Trailer loaded with 155MM SLPs

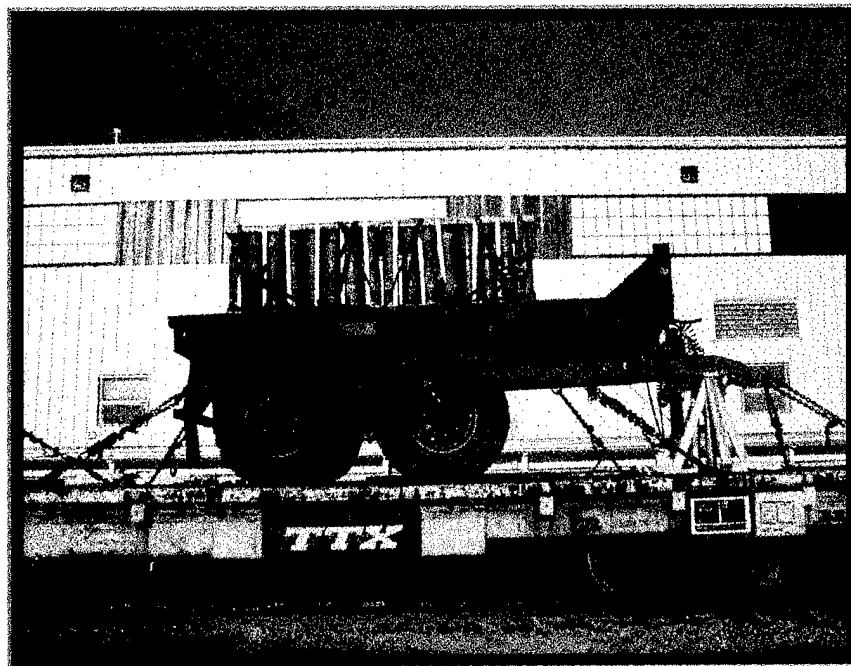
DESCRIPTION	WEIGHT
Flat Car Number: HTTX 95014	67,800 pounds
2.5-Ton Tactical Trailer	6,510 pounds
5-Ton Tactical Trailer	9,200 pounds
Load Type: 155MM SLPs	
2.5 - Ton Tactical Trailer load	5,130 pounds
5 - Ton Tactical Trailer load	10,490 pounds
Total Specimen Weight	99,130 pounds
Buffer Car (four cars) Weight:	250,000 pounds

IMPACT NO.	VELOCITY (MPH)
1	4.43
2	6.59
3	8.72
4	8.57

Remarks: No deficiencies were found upon inspection of the trailers and tiedowns following completion of the rail impact testing.



2.5-Ton Tactical Trailer with 155MM SLPs



5-Ton Tactical Trailer with 155MM SLPs

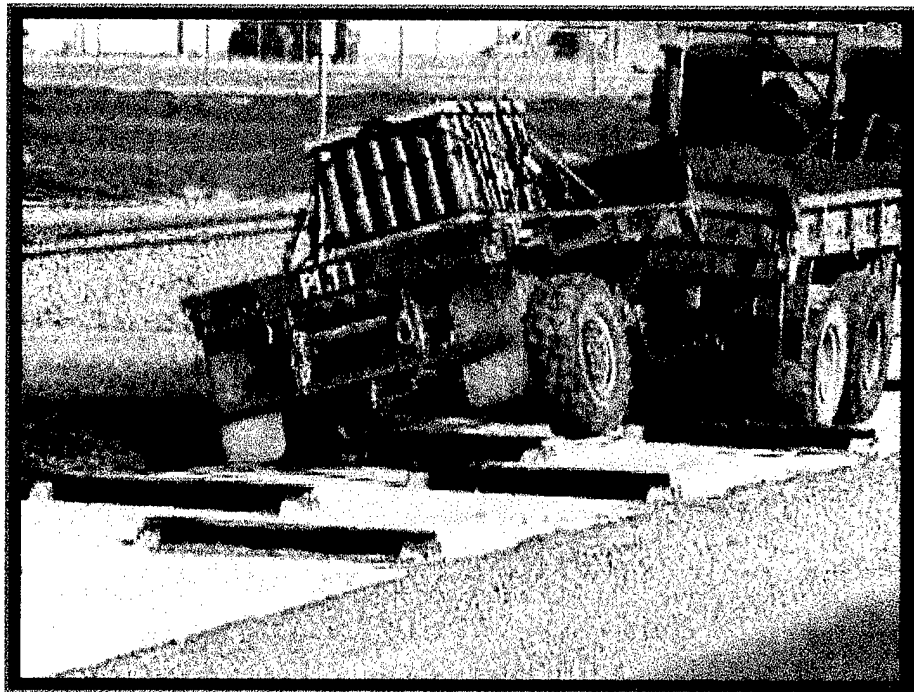
B. **Hazard Course**

Test Date: 24 January 2000

Specimen Load: Rail Ties – 2.5 -Ton Tactical Trailer with 155MM SLPs

PASS NO.	ELAPSED TIME	VELOCITY (MPH)
1	25 Seconds	4.8
2	25 Seconds	4.8
3	23 Seconds	5.2
4	25 Seconds	4.8

Remarks: No damage or failures occurred with the tie-down rings or trailer.



**Hazard Course Testing of 2.5-Ton Tactical Trailer
with 155MM SLPs**

Specimen Load: - 5-Ton Tactical Trailer with 155MM SLPs

PASS NO.	ELAPSED TIME	VELOCITY (MPH)
1	20 Seconds	6.0
2	22 Seconds	5.4
3	27 Seconds	4.4
4	25 Seconds	4.8

Remarks: No damage or failures occurred with the tie-down rings or trailer.



**Hazard Course Testing of 5-Ton Tactical Trailer
with 155MM SLPs**

C. **Road Trip**

Test Date: 24 January 2000

Specimen Load: 2.5-Ton and 5-Ton Tactical Trailers with 155MM SLPs

Remarks: No damage or failures occurred with the tie-down rings or trailer.

D. **Panic Stop Test**

Test Date: 24 January 2000

Specimen Load: 2.5-Ton and 5-Ton Tactical Trailers with 155MM SLPs

Remarks: No damage or failures occurred with the tiedown rings or trailer.

E. **Washboard Course**

Test Date: 24 January 2000

Specimen Load: 2.5-Ton Tactical Trailer with 155MM SLPs

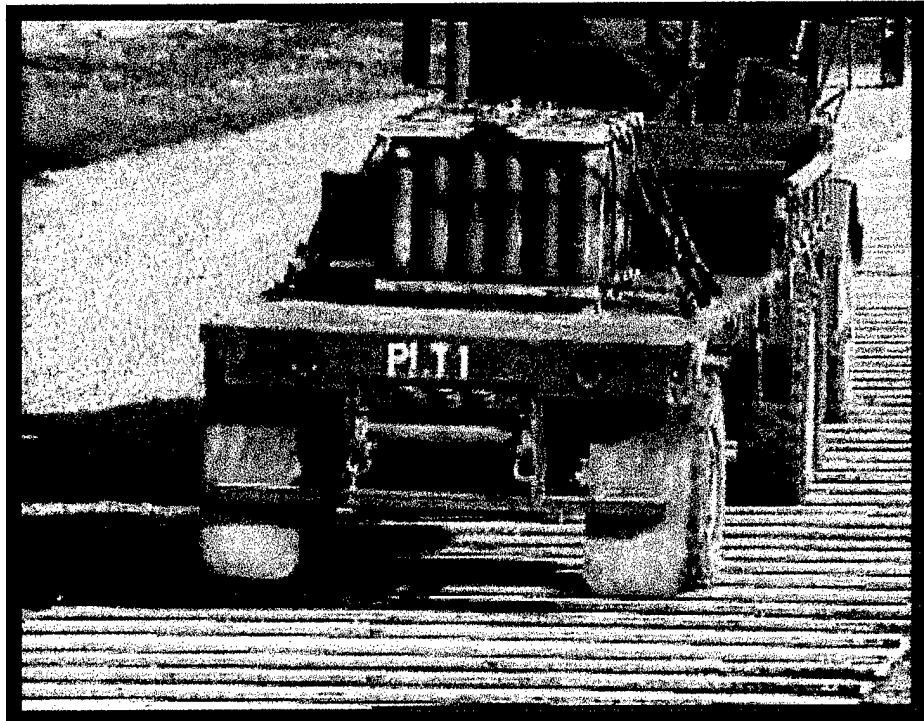
Remarks:

1. No damage or failures occurred with the tie-down rings or trailer.
2. Following completion of test series (hazard, panic stops and washboard) the total load movement was 0.75 inches to the side and 0.25 inch forward.

Specimen Load: 5-Ton Tactical Trailer with 155MM SLPs

Remarks:

1. No damage or failures occurred with the tie-down rings or trailer
2. No load movement.



**Washboard Course of 2.5-Ton Tactical Trailer with
155MM SLPs**

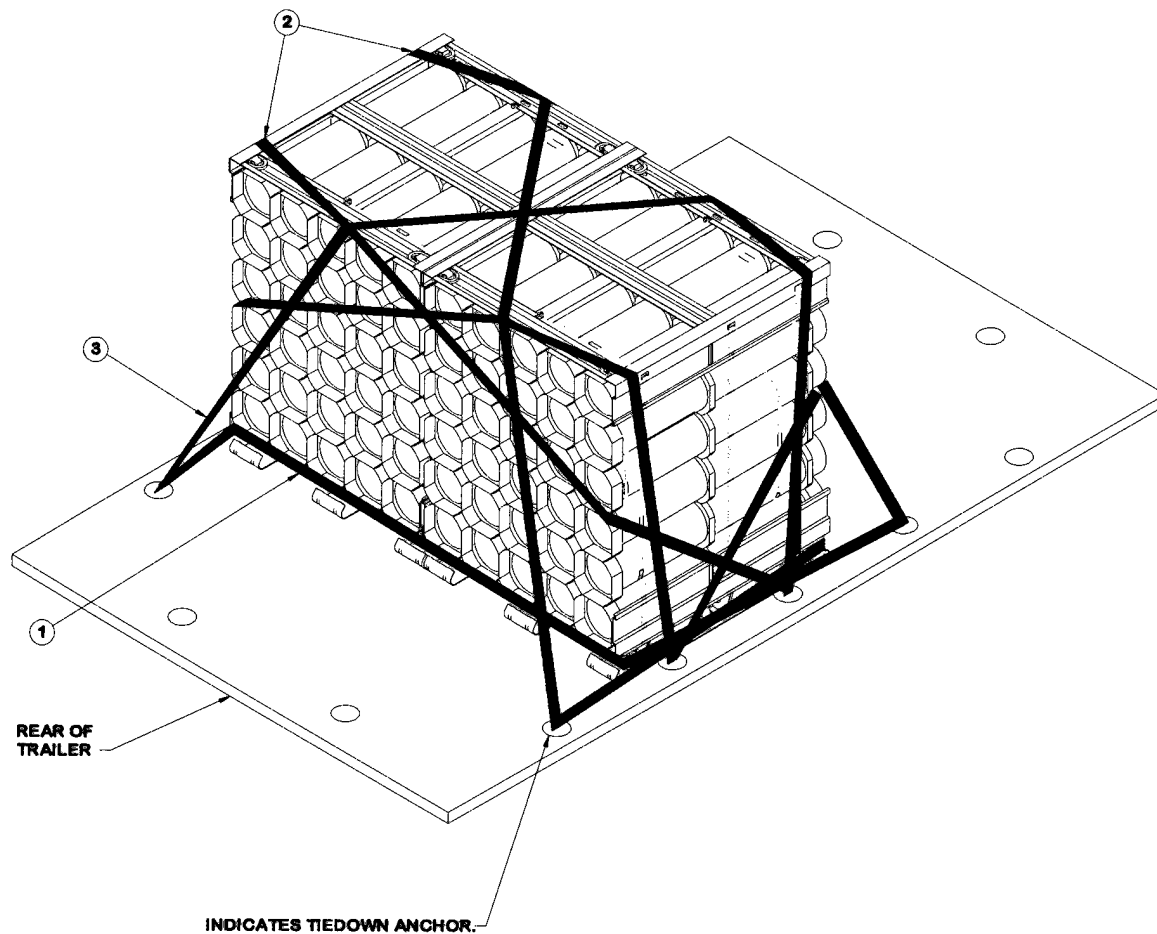
PART 6 – DRAWINGS

TEST SKETCH

LOADING AND TIEDOWN PROCEDURES FOR AMMUNITION ITEMS LOADED ON THE M1082 AND M1095 FMTV TRAILERS

● NOTE: THE AMMUNITION TIEDOWN PROCEDURES CONTAINED WITHIN THIS DOCUMENT ARE TYPICAL. THE DEPICTED ITEMS ARE REPRESENTATIVE OF THE VARIOUS TYPES OF AMMUNITION THAT MAY BE RESTRAINED AND TRANSPORTED ON THE M1082 AND M1095 FMTV TRAILERS. THESE PROCEDURES WERE USED IN SUPPORT OF THE FMTV TRAILER AMMUNITION CERTIFICATION TRANSPORTABILITY TEST PROGRAM.

Prepared during January 2000 by:
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E-mail: dugan@dac-emh2.army.mil

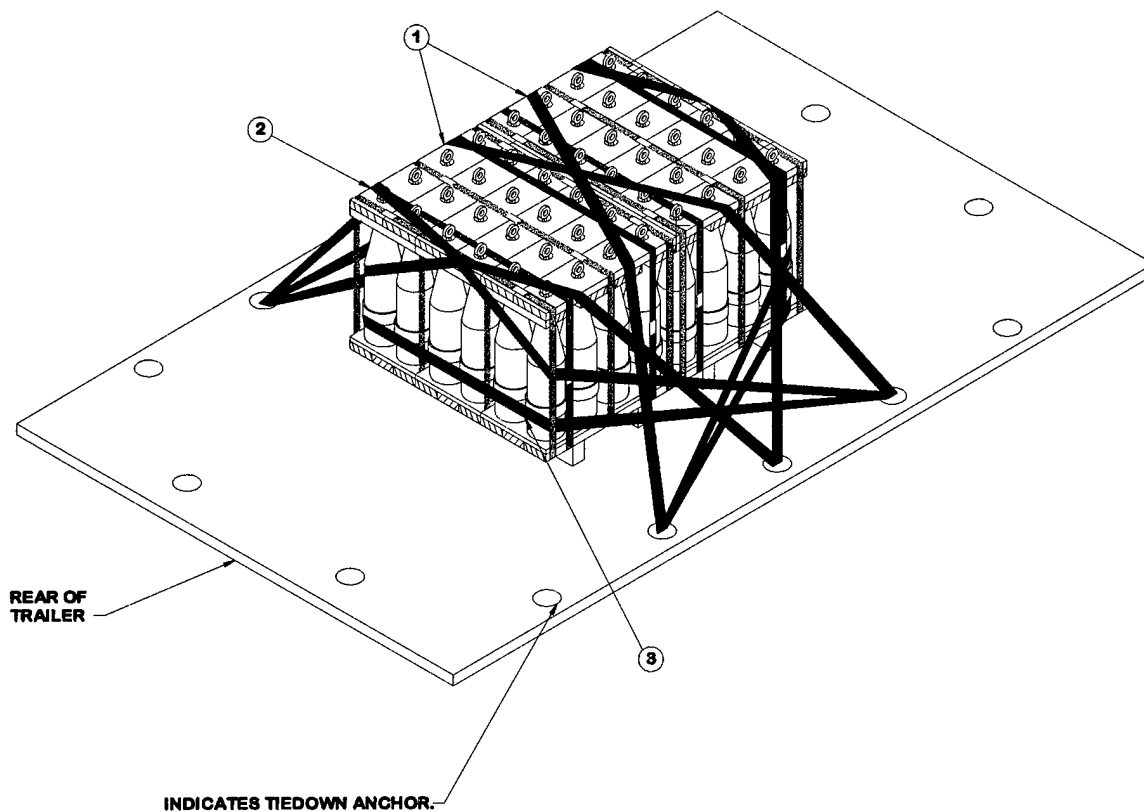


KEY NUMBERS

- ① WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).
- ② WEB STRAP TIEDOWN ASSEMBLY (4 REQUIRED).
- ③ WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).

TEST LOAD AS SHOWN

ITEM	QUANTITY	WEIGHT (APPROX)
PALLETIZED UNIT	2	5,000 LBS



KEY NUMBERS

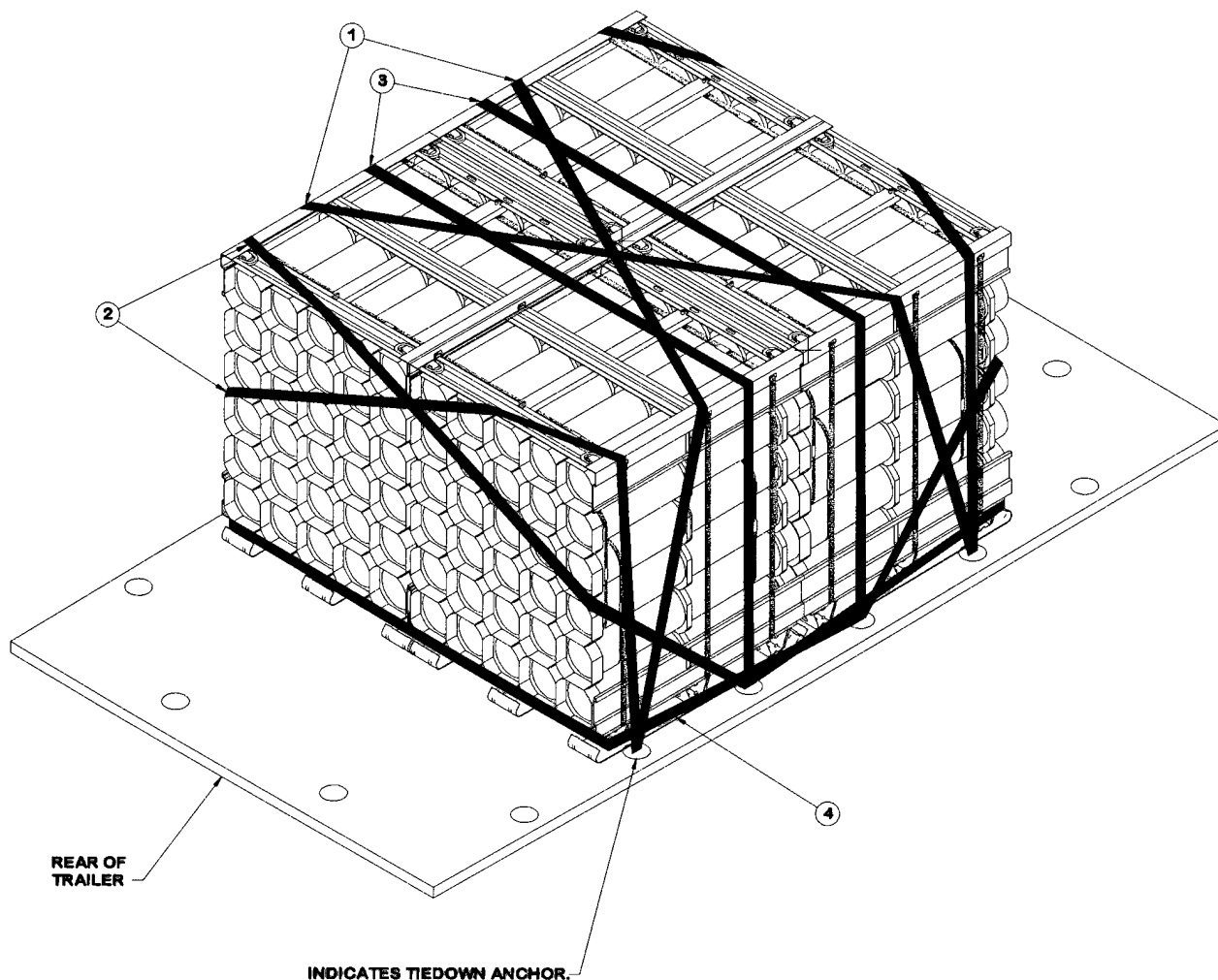
- ① WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).
- ② WEB STRAP TIEDOWN ASSEMBLY (4 REQUIRED).
- ③ WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).

TEST LOAD AS SHOWN

ITEM	QUANTITY	WEIGHT (APPROX)
PALLETIZED UNIT	6	5,000 LBS

155MM PROJECTILE LOAD ON 2-1/2 TON FMTV TRAILER

PAGE 3

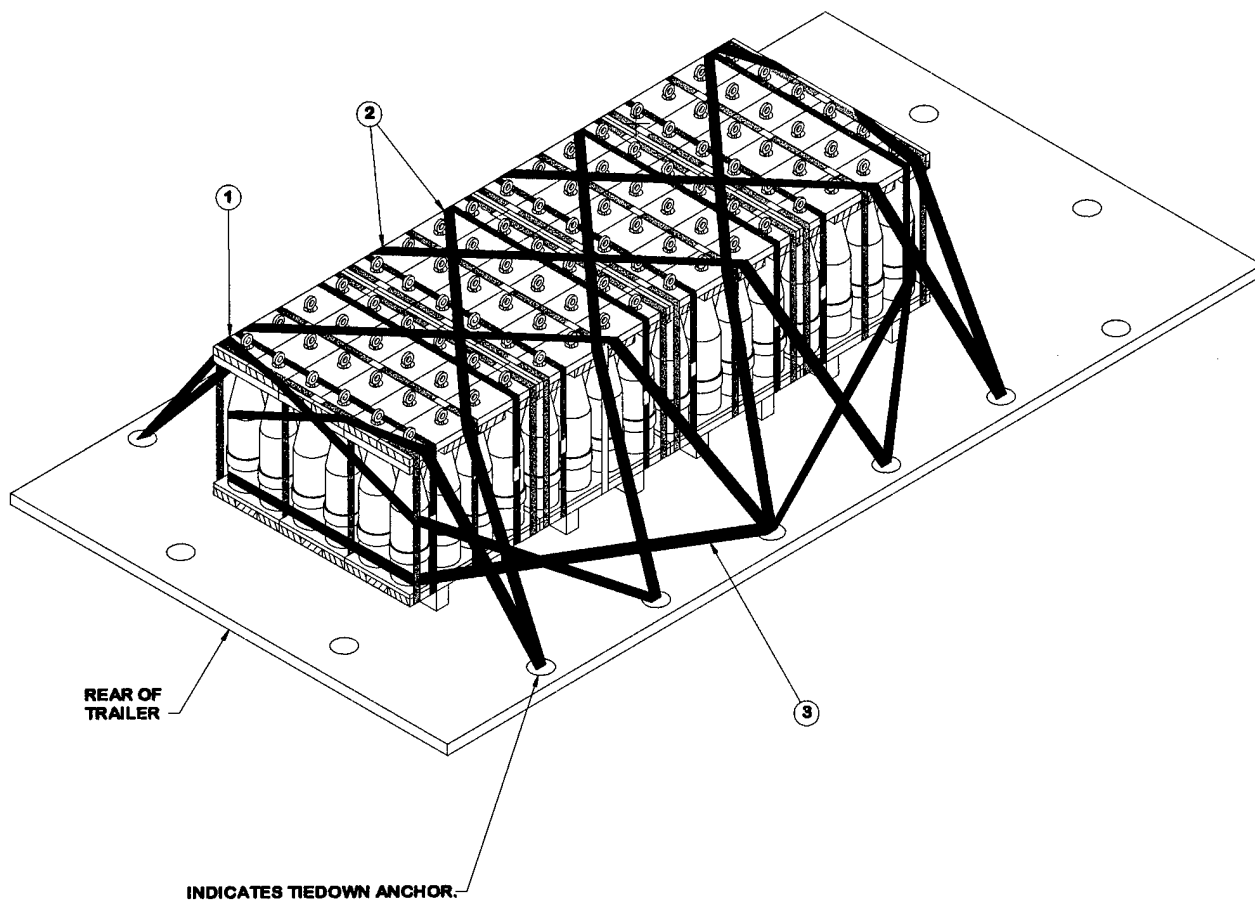


KEY NUMBERS

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- ② WEB STRAP TIEDOWN ASSEMBLY (4 REQUIRED).
- ③ WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).
- ④ WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).

TEST LOAD AS SHOWN

ITEM	QUANTITY	WEIGHT (APPROX)
PALLETIZED UNIT	4	10,000 LBS



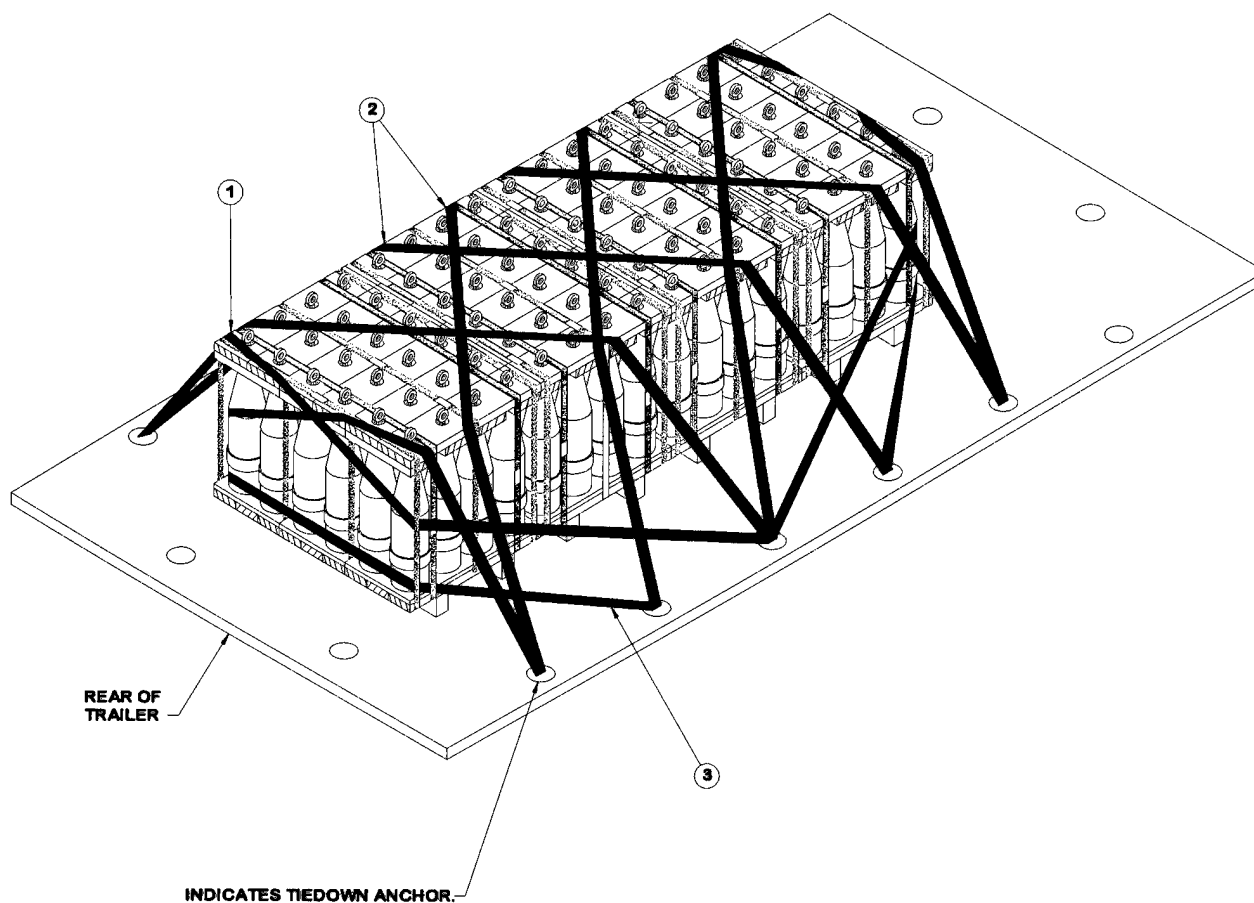
NOTE: THIS DRAWING SHOWS STRAP ASSEMBLIES AS TESTED.
FOR IMPROVED STAP ASSEMBLY LOCATIONS SEE PAGE 6.

KEY NUMBERS

- ① WEB STRAP TIEDOWN ASSEMBLY (4 REQUIRED).
- ② WEB STRAP TIEDOWN ASSEMBLY (6 REQUIRED).
- ③ WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).

TEST LOAD AS SHOWN

ITEM	QUANTITY	WEIGHT (APPROX)
PALLETIZED UNIT	12	12,000 LBS



NOTE: THIS DRAWING SHOWS STRAP ASSEMBLIES
AT IMPROVED LOCATIONS DETERMINED BY TESTING.

KEY NUMBERS

- ① WEB STRAP TIEDOWN ASSEMBLY (4 REQUIRED).
- ② WEB STRAP TIEDOWN ASSEMBLY (6 REQUIRED).
- ③ WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).

TEST LOAD AS SHOWN

ITEM	QUANTITY	WEIGHT (APPROX)
PALLETIZED UNIT	12	12,000 LBS